Figure 1
Sequence ID 1: human interferon alpha 1 (GenBank 13128950)
MASPFALLMVLVVLSCKSSCSLGCDLPETHSLDNRRTLMLLAQMSRISPSSCLMDRHDFGF
PQEEFDGNQFQKAPAISVLHELIQQIFNLFTTKDSSAAWDEDLLDKFCTELYQQLNDLEACV
MQEERVGETPLMNADSILAVKKYFRRITLYLTEKKYSPCAWEVVRAEIMRSLSLSTNLQERL
RRKE

Sequence ID 2: human interferon alpha-2a (GenBank 2781226)
CDLPQTHSLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQ
QIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKYF
QRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESLRSKE

Sequence ID 3: human interferon alpha-2b (GenBank 30171279)
MCDLPQTHSLGSRRTLMLLAQMRRISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMI
QQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKY
FQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESLRSKE

Sequence ID 4: human interferon alpha 4 (GenBank 10835103)
MALSFSLLMAVLVLSYKSICSLGCDLPQTHSLGNRRALILLAQMGRISHFSCLKDRHDFGFP
EEEFDGHQFQKAQAISVLHEMIQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVI
QEVGVEETPLMNEDSILAVRKYFQRITLYLTEKKYSPCAWEVVRAEIMRSLSFSTNLQKRLR
RKD

Sequence ID 5: human interferon alpha 5 (GenBank 4504597)
MALPFVLLMALVVLNCKSICSLGCDLPQTHSLSNRRTLMIMAQMGRISPFSCLKDRHDFGFP
QEEFDGNQFQKAQAISVLHEMIQQTFNLFSTKDSSATWDETLLDKFYTELYQQLNDLEACM
MQEVGVEDTPLMNVDSILTVRKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSLSANLQERL
RRKE

Sequence ID 6: human interferon alpha 6 (GenBank 11128015)
MALPFALLMALVVLSCKSSCSLDCDLPQTHSLGHRRTMMLLAQMRRISLFSCLKDRHDFRF
PQEEFDGNQFQKAEAISVLHEVIQQTFNLFSTKDSSVAWDERLLDKLYTELYQQLNDLEAC
VMQEVWVGGTPLMNEDSILAVRKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSSSRNLQE
RLRRKE

Sequence ID 7: human interferon alpha 7 (GenBank 10800142)
MARSFSLLMAVLVLSYKSICSLGCDLPQTHSLRNRRALILLAQMGRISPFSCLKDRHEFRFP
EEEFDGHQFQKTQAISVLHEMIQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVI
QEVGVEETPLMNEDFILAVRKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSFSTNLKKGLR
RKD

Sequence ID 8: human interferon alpha 8 (GenBank 4504599)
MALTFYLMVALVVLSYKSFSSLGCDLPQTHSLGNRRALILLAQMRRISPFSCLKDRHDFEFP
QEEFDDKQFQKAQAISVLHEMIQQTFNLFSTKDSSAALDETLLDEFYIELDQQLNDLEVLCD
QEVGVIESPLMYEDSILAVRKYFQRITLYLTEKKYSSCAWEVVRAEIMRSFSLSINLQKRLKS
KE

Sequence ID 9: human interferon alpha 10 (GenBank 4504589)
MALSFSLLMAVLVLSYKSICSLGCDLPQTHSLGNRRALILLGQMGRISPFSCLKDRHDFRIPQ
EEFDGNQFQKAQAISVLHEMIQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVIQ
EVGVEETPLMNEDSILAVRKYFQRITLYLIERKYSPCAWEVVRAEIMRSLSFSTNLQKRLRRK
D

Sequence ID 10: human interferon alpha 13 (GenBank 13128966)
MASPFALLMALVVLSCKSSCSLGCDLPETHSLDNRRTLMLLAQMSRISPSSCLMDRHDFGF
PQEEFDGNQFQKAPAISVLHELIQQIFNLFTTKDSSAAWDEDLLDKFCTELYQQLNDLEACV
MQEERVGETPLMNADSILAVKKYFRRITLYLTEKKYSPCAWEVVRAEIMRSLSLSTNLQERL
RRKE

Sequence ID 11: human interferon alpha 14 (GenBank 4504591)
MALPFALMMALVVLSCKSSCSLGCNLSQTHSLNNRRTLMLMAQMRRISPFSCLKDRHDFE
FPQEEFDGNQFQKAQAISVLHEMMQQTFNLFSTKNSSAAWDETLLEKFYIELFQQMNDLEA
CVIQEVGVEETPLMNEDSILAVKKYFQRITLYLMEKKYSPCAWEVVRAEIMRSFSFSTNLQK
RLRRKD

Sequence ID 12: human interferon alpha 16 (GenBank 4504593)
MALSFSLLMAVLVLSYKSICSLGCDLPQTHSLGNRRALILLAQMGRISHFSCLKDRYDFGFP
QEVFDGNQFQKAQAISAFHEMIQQTFNLFSTKDSSAAWDETLLDKFYIELFQQLNDLEACVT
QEVGVEEIALMNEDSILAVRKYFQRITLYLMGKKYSPCAWEVVRAEIMRSFSFSTNLQKGLR
RKD

Sequence ID 13: human interferon alpha 17 (GenBank 10880985)
MALSFSLLMAVLVLSYKSICSLGCDLPQTHSLGNRRALILLAQMGRISPFSCLKDRHDFGLP
QEEFDGNQFQKTQAISVLHEMIQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNNLEACVI
QEVGMEETPLMNEDSILAVRKYFQRITLYLTEKKYSPCAWEVVRAEIMRSLSFSTNLQKILR
RKD

Sequence ID 14: human interferon alpha 21 (4504595)
MALSFSLLMAVLVLSYKSICSLGCDLPQTHSLGNRRALILLAQMGRISPFSCLKDRHDFGFP
QEEFDGNQFQKAQAISVLHEMIQQTFNLFSTKDSSATWEQSLLEKFSTELNQQLNDMEACV
IQEVGVEETPLMNVDSILAVKKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSLSKIFQERLR
RKE

Sequence ID 15: human interferon beta (GenBank 124469), signal peptide deleted
MSYNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYE
MLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKR
YYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRN

Sequence ID 16: human interferon kappa (GenBank 14488028)
MSTKPDMIQKCLWLEILMGIFIAGTLSLDCNLLNVHLRRVTWQNLRHLSSMSNSFPVECLRE
NIAFELPQEFLQYTQPMKRDIKKAFYEMSLQAFNIFSQHTFKYWKERHLKQIQIGLDQQAEY

LNQCLEEDENENEDMKEMKENEMKPSEARVPQLSSLELRRYFHRIDNFLKEKKYSDCAWEI
VRVEIRRCLYYFYKFTALFRRK

Sequence ID 17: human interferon tau (GenBank 28882045)
MIIKHFFGTVLVLLASTTIFSLDLKLIIFQQRQVNQESLKLLNKLQTLSIQQCLPHRKNFLLPQK
SLSPQQYQKGHTLAILHEMLQQIFSLFRANISLDGWEENHTEKFLIQLHQQLEYLEALMGLE
AEKLSGTLGSDNLRLQVKMYFRRIHDYLENQDYSTCAWAIVQVEISRCLFFVFSLTEKLSKQ
GRPLNDMKQELTTEFRSPR

Sequence ID 18: human interferon omega (GenBank 4504605)
MALLFPLLAALVMTSYSPVGSLGCDLPQNHGLLSRNTLVLLHQMRRISPFLCLKDRRDFRFP
QEMVKGSQLQKAHVMSVLHEMLQQIFSLFHTERSSAAWNMTLLDQLHTGLHQQLQHLETC
LLQVVGEGESAGAISSPALTLRRYFQGIRVYLKEKKYSDCAWEVVRMEIMKSLFLSTNMQE
RLRSKDRDLGSS

Sequence ID 19: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 27 and 28, linker connection between residues 159 and 9)
SCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELY
QQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSF
SLSTNLQE-(linker)-LGSRRTLMLLAQMRKISLF

Sequence ID 20: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 48 and 49, linker connection between residues 159 and 9, linker = "RAGN")
KAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLM
KEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQERAGNLGSRRTLMLL
AQM RKISLFSCLKDRHDFGFPQEEFGNQFQ

Sequence ID 21: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 76 and 77, linker connection between residues 159 and 9, linker = "RAGN")
DETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCA
WEVVRAEIMRSFSLSTNLQERAGNLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEFGN
QFQ KAETIPVLHEMIQQIFNLFSTKDSSAAW

Sequence ID 22: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 105 and 106, linker connection between residues 159 and 9, linker = "RAGN")
TETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQERAGNLGSR
R
TLMLLAQMRKISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAA
WDETLLDKFYTELYQQLNDLEACVIQGVGV

Sequence ID 23: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 27 and 28, linker connection between residues 159 and 9, linker = "WAST")

SCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELY
QQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSF
SLSTNLQEWASTLGSRRTLMLLAQMRKISLF

Sequence ID 24: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 48 and 49, linker connection between residues 159 and 9, linker = "WAST")
KAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLM
KEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQE-(linker)-
LGSRRTLMLLAQM RKISLFSCLKDRHDFGFPQEEFGNQFQ

Sequence ID 25: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 76 and 77, linker connection between residues 159 and 9, linker = "WAST")
DETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCA
WEVVRAEIMRSFSLSTNLQEWASTLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEFGN
QFQ KAETIPVLHEMIQQIFNLFSTKDSSAAW

Sequence ID 26: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 105 and 106, linker connection between residues 159 and 9, linker = "WAST")
TETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQEWASTLGSR
RT
LMLLAQMRKISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAAW
DETLLDKFYTELYQQLNDLEACVIQGVGV

Sequence ID 27: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 27 and 28, linker connection between residues 159 and 9, linker = "SGNK")
SCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELY
QQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSF
SLSTNLQESGNKLGSRRTLMLLAQMRKISLF

Sequence ID 28: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 48 and 49, linker connection between residues 159 and 9, linker = "SGNK")
KAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLM
KEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESGNKLGSRRTLMLL
AQM RKISLFSCLKDRHDFGFPQEEFGNQFQ

Sequence ID 29: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 76 and 77, linker connection between residues 159 and 9, linker = "SGNK")
DETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCA
WEVVRAEIMRSFSLSTNLQESGNKLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEFGN
QFQ KAETIPVLHEMIQQIFNLFSTKDSSAAW

Sequence ID 30: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 105 and 106, linker connection between residues 159 and 9, linker = "SGNK")
TETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESGNKLGSR
R
TLMLLAQMRKISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAA
WDETLLDKFYTELYQQLNDLEACVIQGVGV

Sequence ID 31: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 27 and 28, linker connection between residues 159 and 9, linker = "QNTKS")
SCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELY
QQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSF
SLSTNLQE-(linker)-LGSRRTLMLLAQMRKISLF

Sequence ID 32: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 48 and 49, linker connection between residues 159 and 9, linker = "QNTKS")
KAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLM
KEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQEQNTKSLGSRRTLML
LAQM RKISLFSCLKDRHDFGFPQEEFGNQFQ

Sequence ID 33: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 76 and 77, linker connection between residues 159 and 9, linker = "QNTKS")
DETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEKKYSPCA
WEVVRAEIMRSFSLSTNLQEQNTKSLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEFG
NQFQ KAETIPVLHEMIQQIFNLFSTKDSSAAW

Sequence ID 34: circularly permuted variant of interferon-alpha 2a (breakpoint located between residues 105 and 106, linker connection between residues 159 and 9, linker = "QNTKS")
TETPLMKEDSILAVRKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQEQNTKSLGS
RR
TLMLLAQMRKISLFSCLKDRHDFGFPQEEFGNQFQKAETIPVLHEMIQQIFNLFSTKDSSAA
WDETLLDKFYTELYQQLNDLEACVIQGVGV

Sequence ID 35: circularly permuted variant of interferon-beta (breakpoint located between residues 27 and 28, linker connection between residues 4 and 165, linker = "GD")
LEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLAN
VYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRN
FYFINRLTGYLRGDNLLGFLQRSSNFQCQKLLWQLNGR

Sequence ID 36: circularly permuted variant of interferon-beta (breakpoint located between residues 47 and 48, linker connection between residues 4 and 165, linker = "GD")

QQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKED
FTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRGDNLLGFL
QRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQL

Sequence ID 37: circularly permuted variant of interferon-beta (breakpoint located between residues 77 and 78, linker connection between residues 4 and 165, linker = “GD”)
GWNETIVENLLANVYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYS
HCAWTIVRVEILRNFYFINRLTGYLRGDNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDRM
NFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSST

Sequence ID 38: circularly permuted variant of interferon-beta (breakpoint located between residues 109 and 110, linker connection between residues 4 and 165, linker = “GD”)
DFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRGDNLLGF
LQRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIF
RQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKE

Sequence ID 39: circularly permuted variant of interferon-beta (breakpoint located between residues 136 and 137, linker connection between residues 4 and 165, linker = “GD”)
YSHCAWTIVRVEILRNFYFINRLTGYLRGDNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKD
RMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINH
LKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKE

Sequence ID 40: circularly permuted variant of interferon-beta (breakpoint located between residues 27 and 28, linker connection between residues 4 and 165, linker = “DT”)
LEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLAN
VYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRN
FYFINRLTGYLRDTNLLGFLQRSSNFQCQKLLWQLNGR

Sequence ID 41: circularly permuted variant of interferon-beta (breakpoint located between residues 47 and 48, linker connection between residues 4 and 165, linker = “DT’)
QQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKED
FTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRDTNLLGFL
QRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQL

Sequence ID 42: circularly permuted variant of interferon-beta (breakpoint located between residues 77 and 78, linker connection between residues 4 and 165, linker = “DT”)
GWNETIVENLLANVYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYS
HCAWTIVRVEILRNFYFINRLTGYLRDTNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDRM
NFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSST

Sequence ID 43: circularly permuted variant of interferon-beta (breakpoint located between residues 109 and 110, linker connection between residues 4 and 165, linker = “DT”)
DFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRDTNLLGF
LQRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIF
RQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKE

Sequence ID 44: circularly permuted variant of interferon-beta (breakpoint located between residues 136 and 137, linker connection between residues 4 and 165, linker = “DT”)
YSHCAWTIVRVEILRNFYFINRLTGYLRDTNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDR
MNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHL
KTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKE

Sequence ID 45: circularly permuted variant of interferon-beta (breakpoint located between residues 27 and 28, linker connection between residues 4 and 165, linker = “QS”)
LEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLAN
VYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRN
FYFINRLTGYLRQSNLLGFLQRSSNFQCQKLLWQLNGR

Sequence ID 46: circularly permuted variant of interferon-beta (breakpoint located between residues 47 and 48, linker connection between residues 4 and 165, linker = “QS”)
QQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKED
FTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRQSNLLGFL
QRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQL

Sequence ID 47: circularly permuted variant of interferon-beta (breakpoint located between residues 77 and 78, linker connection between residues 4 and 165, linker = “QS”)
GWNETIVENLLANVYHQINHLKTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKEYS
HCAWTIVRVEILRNFYFINRLTGYLRQSNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDRM
NFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSST

Sequence ID 48: circularly permuted variant of interferon-beta (breakpoint located between residues 109 and 110, linker connection between residues 4 and 165, linker = “QS”)
DFTRGKLMSSLHLKRYYGRILHYLKAKEYSHCAWTIVRVEILRNFYFINRLTGYLRQSNLLGF
LQRSSNFQCQKLLWQLNGRLEYCLKDRMNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIF
RQDSSSTGWNETIVENLLANVYHQINHLKTVLEEKLEKE

Sequence ID 49: circularly permuted variant of interferon-beta (breakpoint located between residues 136 and 137, linker connection between residues 4 and 165, linker = “QS”)
YSHCAWTIVRVEILRNFYFINRLTGYLRQSNLLGFLQRSSNFQCQKLLWQLNGRLEYCLKDR
MNFDIPEEIKQLQQFQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHL
KTVLEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAKE

Figure 2

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 1: 24   CDLPETHSLDNRRTLMLLAQMSRISPSSCLMDRHDFGFPQEEFDGNQFQKAPAISVLHEL 83
2a: 2    CDLPQTHSLGSRRTLMLLAQMRKISLFSCLKDRHDFGFPQEEF-GNQFQKAETIPVLHEM 60
2b: 2    CDLPQTHSLGSRRTLMLLAQMRRISLFSCLKDRHDFGFPQEEF-GNQFQKAETIPVLHEM 60
 4: 24   CDLPQTHSLGNRRALILLAQMGRISHFSCLKDRHDFGFPEEEFDGHQFQKAQAISVLHEM 83
 5: 24   CDLPQTHSLSNRRTLMIMAQMGRISPFSCLKDRHDFGFPQEEFDGNQFQKAQAISVLHEM 83
 6: 24   CDLPQTHSLGHRRTMMLLAQMRRISLFSCLKDRHDFRFPQEEFDGNQFQKAEAISVLHEV 83
 7: 24   CDLPQTHSLRNRRALILLAQMGRISPFSCLKDRHEFRFPEEEFDGHQFQKTQAISVLHEM 83
 8: 24   CDLPQTHSLGNRRALILLAQMRRISPFSCLKDRHDFEFPQEEFDDKQFQKAQAISVLHEM 83
10: 24   CDLPQTHSLGNRRALILLGQMGRISPFSCLKDRHDFRIPQEEFDGNQFQKAQAISVLHEM 83
13: 24   CDLPETHSLDNRRTLMLLAQMSRISPSSCLMDRHDFGFPQEEFDGNQFQKAPAISVLHEL 83
14: 24   CNLSQTHSLNNRRTLMLMAQMRRISPFSCLKDRHDFEFPQEEFDGNQFQKAQAISVLHEM 83
16: 24   CDLPQTHSLGNRRALILLAQMGRISHFSCLKDRYDFGFPQEVFDGNQFQKAQAISAFHEM 83
17: 24   CDLPQTHSLGNRRALILLAQMGRISPFSCLKDRHDFGLPQEEFDGNQFQKTQAISVLHEM 83
21: 24   CDLPQTHSLGNRRALILLAQMGRISPFSCLKDRHDFGFPQEEFDGNQFQKAQAISVLHEM 83

 1: 84   IQQIFNLFTTKDSSAAWDEDLLDKFCTELYQQLNDLEACVMQEERVGETPLMNADSILAV 143
2a: 61   IQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAV 120
2b: 61   IQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLEACVIQGVGVTETPLMKEDSILAV 120
 4: 84   IQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVIQEVGVEETPLMNEDSILAV 143
 5: 84   IQQTFNLFSTKDSSATWDETLLDKFYTELYQQLNDLEACMMQEVGVEDTPLMNVDSILTV 143
 6: 84   IQQTFNLFSTKDSSVAWDERLLDKLYTELYQQLNDLEACVMQEVWVGGTPLMNEDSILAV 143
 7: 84   IQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVIQEVGVEETPLMNEDFILAV 143
 8: 84   IQQTFNLFSTKDSSAALDETLLDEFYIELDQQLNDLEVLCDQEVGVIESPLMYEDSILAV 143
10: 84   IQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNDLEACVIQEVGVEETPLMNEDSILAV 143
13: 84   IQQIFNLFTTKDSSAAWDEDLLDKFCTELYQQLNDLEACVMQEERVGETPLMNADSILAV 143
14: 84   MQQTFNLFSTKNSSAAWDETLLEKFYIELFQQMNDLEACVIQEVGVEETPLMNEDSILAV 143
16: 84   IQQTFNLFSTKDSSAAWDETLLDKFYIELFQQLNDLEACVTQEVGVEEIALMNEDSILAV 143
17: 84   IQQTFNLFSTEDSSAAWEQSLLEKFSTELYQQLNNLEACVIQEVGMEETPLMNEDSILAV 143
21: 84   IQQTFNLFSTKDSSATWEQSLLEKFSTELNQQLNDMEACVIQEVGVEETPLMNVDSILAV 143

 1: 144 KKYFRRITLYLTEKKYSPCAWEVVRAEIMRSLSLSTNLQERLRRKE 189
2a: 121 RKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESLRSKE 166
2b: 121 RKYFQRITLYLKEKKYSPCAWEVVRAEIMRSFSLSTNLQESLRSKE 166
 4: 144 RKYFQRITLYLTEKKYSPCAWEVVRAEIMRSLSFSTNLQKRLRRKD 189
 5: 144 RKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSLSANLQERLRRKE 189
 6: 144 RKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSSSRNLQERLRRKE 189
 7: 144 RKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSFSTNLKKGLRRKD 189
 8: 144 RKYFQRITLYLTEKKYSSCAWEVVRAEIMRSFSLSINLQKRLKSKE 189
10: 144 RKYFQRITLYLIERKYSPCAWEVVRAEIMRSLSFSTNLQKRLRRKD 189
13: 144 KKYFRRITLYLTEKKYSPCAWEVVRAEIMRSLSLSTNLQERLRRKE 189
14: 144 KKYFQRITLYLMEKKYSPCAWEVVRAEIMRSFSFSTNLQKRLRRKD 189
16: 144 RKYFQRITLYLMGKKYSPCAWEVVRAEIMRSFSFSTNLQKGLRRKD 189
17: 144 RKYFQRITLYLTEKKYSPCAWEVVRAEIMRSLSFSTNLQKILRRKD 189
21: 144 KKYFQRITLYLTEKKYSPCAWEVVRAEIMRSFSLSKIFQERLRRKE 189
```

Figure 3

```
IFNK: ldcnllnvhlrrvtwqnlrhlssmsnsfpveclreniafelpqeflqytq
1AU1: MSYNLLGFLQRSSNFQCQKLLWQLNGRLEY-CLKDRMNFDIPEEIKQLQQ
1B5L:   CYLSRKLMLDAR-ENLKLLDRMNRLSPHSCLQDRKDFGLPQEMVEGDQ
1ITF:   CDLPQTHSLGSR-RTLMLLAQMRKISLFSCLKDRHDFGFPQE-EFGNQ

IFNK: pmkrdikkafyemslqafnifsqht--fkywkerhkqiqigldqqaeyln
1AU1: FQKEDAALTIYEMLQNIFAIFRQDSSSTGWNETIVENLLANVYHQINHLK
1B5L: LQKDQAFPVLYEMLQQSFNLFYTEHSSAAWDTTLLEQLCTGLQQQLDHLD
1ITF: FQKAETIPVLHEMIQQIFNLFSTKDSSAAWDETLLDKFYTELYQQLNDLE

IFNK: qcleedenenedmkemkenemkpsearvpqlsslelrryfhridnflkek
1AU1: TV-------------LEEKLEKEDFTRGKLMSSLHLKRYYGRILHYLKAK
1B5L: TC------------------------RG|MDPIVTVKKYFQGIYDYLQEK
1ITF: AC-------------VIQGVGVTETPLMKEDSILAVRKYFQRITLYLKEK

IFNK: kysdcaweivrveirrclyyfykftalfrrk
1AU1: EYSHCAWTIVRVEILRNFYFINRLTGYLRN
1B5L: GYSDCAWEIVRVEMMRALTVSTTLQKRLTK
1ITF: KYSPCAWEVVRAEIMRSFSLSTNLQESLRSKE
```